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ABSTRACT

This bibliography contains information on technology education for use at the middle, junior, and senior high school levels. Materials for implementing technology education and technological literacy are also included. Thirty-four citations from ERIC and other databases include curriculum materials, teacher guides, behavioral objectives, journals, articles, conference proceedings, position papers, and task analyses. Four articles, representative of current wisdom in the field, are reprinted: "Uniting to Promote Technology Education: (Alice Van Deursen, Nina Kelty); "Making the Change: Key Issues in Moving to Technology Education" (Merrill Oaks); "It Wouldn't Work with My Students" (James Mooney); and "The Woodlands, Texas" (Larry McHaney, Jerry Bernhardt). Each entry in the annotated bibliography has these components: title, date, author, developer, availability, annotation, and format. A final section contains information on The Technology Bank, a clearinghouse of the International Technology Education Association. (YLB)

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Technology Education

A Bibliography Update

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Technology Education

A Bibliography Update

State of Florida
Department of Education
Tallahassee, Florida
Betty Castor, Commissioner
Affirmative action/equal opportunity employer

Division of Vocational, Adult, and Community Education

March 1990

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Introduction

This is an update of *Technology Education: A Bibliography* (December 1988). It contains the most recent information available on technology education and, like the bibliography, is intended for use at the middle, junior, and senior high school levels. Materials for implementing technology education and technological literacy are also included.

The citations contain curriculum materials, teacher guides, behavioral objectives, journals, articles, conference proceedings, position papers, and task analyses.

Materials included in this bibliography update were located through Florida Educational Information Service (FEIS). FEIS conducted searches of computerized information-retrieval systems (specifically the ERIC [Educational Resources Information Center] data base on DIALOG, and the VECM [Vocational Education Curriculum Materials] data base on BRS [Bibliographic Retrieval Services]).

FEIS is sponsored by the Florida Division of Vocational, Adult, and Community Education and is located in the Center for Instructional Development and Services, Florida State University.

For additional search information, contact Florida Educational Information Service, Center for Instructional Development and Services, 2003 Apalachee Parkway, Suite 301, Tallahassee, FL 32301-4829, (904) 487-2054.

Van Deursen, Alice, and Kelty, Nina. (1989). "Uniting to Promote Technology Education." *The Technology Teacher*. *48*(8), 23, 25–27.

Describes the work by New Jersey's Commission on Technology to heighten curiosity and awareness of technology and to develop a K–12 technology curriculum.

Oaks, Merrill M. (1989). "Making the Change: Key Issues in Moving to Technology Education." *The Technology Teacher*. *48*(5), 5–8.

Identifies and discusses major issues that are involved in the change from industrial arts to technology education.

Mooney, James J. (1989). "It Wouldn't Work with My Students." *The Technology Teacher*. *48*(5), 3–4.

Addresses common reactions of teachers to the new technology-education curriculum.

McHaney, Larry J., and Bernhardt, Jerry. (1988). "The Woodlands, Texas." *The Technology Teacher*. *48*(1), 11–16.

Describes the "central project" concept for implementing technology education while addressing education reform.

Uniting to Promote Technology Education

Alice Van Deursen and Nina Kelty

There's a revolution taking place—but it's not the kind associated with the overthrow of a government. No, it's a technological revolution and it's taking place not only in the United States but worldwide as well.

Have America's public schools kept pace with this revolution? Yes, and no.

Five years ago, the National Science Board issued a report sharply attacking public schools for failing to meet the technological challenge. In its 1983 report, *Educating American's for the 21st Century*, the board warned that the United States, which "dramatically and boldly led the world into the age of technology, is failing to provide its own children with the intellectual tools needed for the 21st century." Similar reports and numerous articles in magazines and newspapers have reiterated the concern that our country is raising a generation of technologically illiterate citizens.

Recently, legislators and educators have been responding to such warnings and criticisms. Legislation calling for the establishment of several technology education demonstration centers throughout our country recently was re-introduced, passed by the U.S. House of Representatives and Senate and signed by the President. According to the Technological Literacy Act, the centers would serve as a valuable source of training for teachers, offering the necessary background and in-service programs they need to produce technologically literate students.

Van Deursen is Project Director of the Commission on Technology Education for the State of New Jersey. Kelty is a member of that Commission. This is a refereed article.

The New Jersey Answer

New Jersey is answering the technological challenge through the work of the Commission on Technology Education for the State of New Jersey. The Commission was formed in 1985 to promote technological literacy through Technology Education. The project is funded by the State Department of Education's, Division of Vocational Education to facilitate the transition from industrial arts to Technology Education.

The grant was awarded to the Department of Industrial Studies of Montclair State College. Dr. Vince Walencik serves as Executive Director of the Commission. The primary objective was to heighten students' curiosity and awareness of technology and to develop a technology curriculum serving K-12 population.

Under the guidance of the Commission, technology teachers develop and pilot test innovative technology concepts and courses. In addition, the Commission provides in-service teacher training to assist the classroom practitioner in the implementation of these concepts into their existing curricula. The Commission has also endorsed the assessment of industrial arts programs using the New Jersey Standards for Industrial Arts. Currently, *Standards for Technology Education* are being developed.

The Commission for Technology Education is unique and effective because its membership comes not only from the ranks of education and educational administration but from corporations, businesses and government groups who see the need to give students the skills necessary to become technologically literate workers and citizens. Executives from New Jersey Bell and Public Service Electric and Gas Company serve as corporate representatives on the Commission.

In addition, membership includes professionals from the New Jersey School Boards Association, the New Jersey Commission on Science and Technology, the Technology Education Association of New Jersey, New Jersey Technology for Children Association, school administrators and state colleges involved in Technology Teacher Education.

Membership is divided into the following working subcommittees: publications, research and assessment, curriculum development, teacher certification, Technology Education proficiencies, technology conference, facility demonstration site standards, recognition and scholarships.

The Commission meets monthly to report on subcommittee activities and to make policy decisions. Through the work of these groups, New Jersey has received both national and international recognition as a leader in the Technology Education movement.

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An important role of the Commission is highlighting exemplary Technology Education programs through articles in the media, videotapes and presentations. The message sent to teachers, administrators, and parents is clear—Technology Education works!

A recent example of the success of the public information effort was the March 1988 edition of the *New Jersey Bell Tel-News*: "Technology is for Everyone." This educational service message spotlighting Technology Education was disseminated to 2.8 million households as an insert in telephone bills. The substantial feedback and requests for further information attest to the fact that citizens are interested in introducing these concepts to their children and interested in learning where they too can go to obtain technological literacy.

Curriculum Development

Curriculum development is a major focus of the Commission. Many innovative programs are initiated and developed through standard education channels—teachers talking to teachers, administrators to administrators, school board members, etc. Technology Education, as envisioned by the Commission, is particularly effective and relevant because of its first hand knowledge of the needs and concerns of business and government, teachers and students.

The Commission members are able to translate their professional, diversified experience to the classroom through the development of Technology Education curricula. If the goal of Technology Education is a technologically literate society which can function on a personal and professional level, business and industry must be part of the curriculum development process.

Definition of Terms

The 1987 Report of the Commission on Technology Education for the State of New Jersey defined Technology Education as "both a new curriculum and a strategy for teaching. Technology Education draws its content from the pervasive influence of technology. In order to understand Technology Education it is important to understand what is meant by the concept 'technology'."

It is a challenge to open a newspaper or news magazine today and not find the word "technology." It has become the buzzword for the 80's. Most people when asked to define the word respond with uncertainty but feel sure technology has something to do with computers. Technology has become synonymous with computerized machinery, VCRs, compact discs, etc. In reality, these "things" are the result of technology itself. These results of technology leave out the creativity, brain power and humanity which began the technological process.

Technology is therefore viewed as a process rather than an artifact. Technology as defined by the Commission is "the application of knowledge to satisfy human needs and wants, and to extend human capabilities." To understand the technological process one must identify problems, analyze available resources, understand their interrelationships and predict results which then allows for the modification of the physical world to meet human needs.

Students learn to "think" independently rather than simply follow a text book process of learning. The Commission members knew from their first hand professional experience, that the technological revolution made projections of future career and job skills impossible but the ability to solve problems which arise from change was a "life skill."

The Commission then developed the New Jersey Technology Education Curriculum Model, using the problem solving methodology as the vehicle. The teacher acts as the liaison between the technology problem and the solution, guiding the student through the learning process. The students learn the concepts of problem solving while engaged in designing and realizing solutions (Figure 1) which emphasize the continuing and holistic nature of the process.

Technology Education Methodology

After defining technology, the Commission set goals and developed curricula. A basic objective was to expose students to the role of "decision maker" in the technology process. The role of the teacher was modified to act as a facilitator for learning as compared to the traditional primary source of knowledge.

New Jersey Technology Education Model

Technology Education teaches students the process of technical problem solving through first hand experiences in technology. The Commission suggests the utilization of the New Jersey Technology Education Model (Figure 2) as the means to further that goal. The model is a recommended delivery system which spans

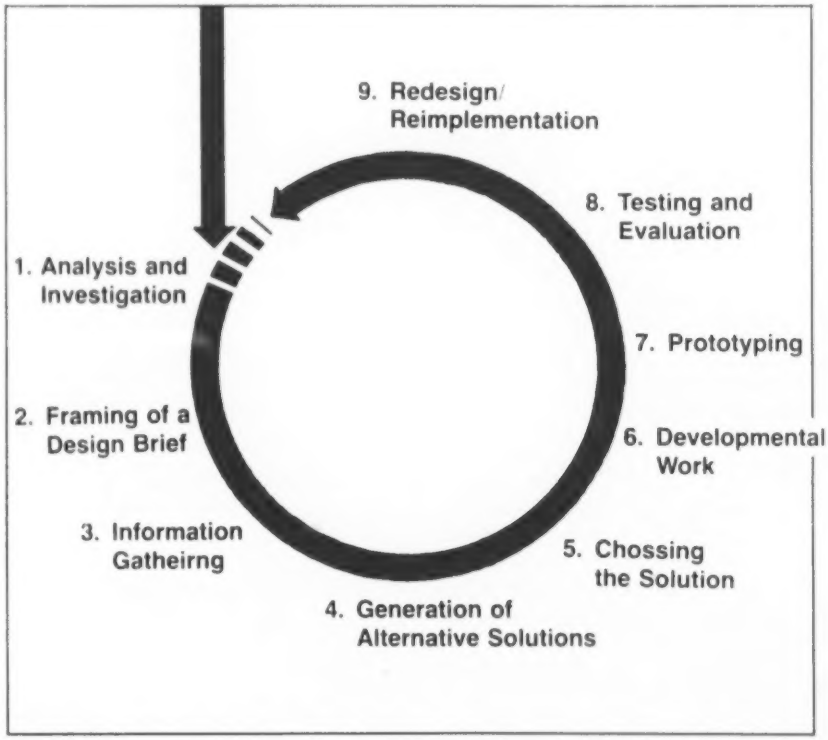

FIGURE 1
Problem solving model

age groups, ability levels and subject areas. The curriculum is divided into the following levels:

Elementary

Called "Technology for Children," this program addresses the need for teaching technology at the K-6 grade levels. Through hands-on experiences, children learn how to solve practical problems. The program is designed to be integrated into the traditional K-6 curriculum. Children have an opportunity to learn life skills that will help them to become more self-directed and creative. They can begin to grasp the basics of thinking techniques which will lead to an ability to apply knowledge to solve even greater problems in the future.

Secondary

Level I, entitled "Introduction to Technology" for grades 7–10, is divided into six units of instruction: Introduction to Technology; Design/Problem Solving in Technology; History/Evolution of Technology; Systems of Technology; Resources of Technology and Control Technology.

Upper level

Courses are under development for grades 9–12. They will include, but are not limited to, such courses as Entrepreneurship, Transportation, Communications, Invention and Innovation, Biotechnology, Technical Design and

CONCEPT PHASE	*LEVEL*	*GRADE*	*GOALS*	*COURSES* *
Developing an awareness of technology	Elem	K-6	Develop an awareness of technology as a significant force in their lives Begin to develop life skills in problem solving Develop the idea that technology is the application of knowledge to solve human problems and extend capabilities	Technology for Children
Exploring technology	I	7–10	Develop consumer skills and literacy Develop critical thinking and problem solving skills Provide exposure to a broad range of career and occupations Engage students in first hand experiences with technology Demonstrate how technology brings together knowledge and skills from all disciplines	Introduction to Technology †
Studying technology	II	9–12	Develop an understanding of technological issues facing citizens of New Jersey Further develop and use critical thinking and problem solving skills Apply math and science principles to the solution of problems Develop an understanding of the impacts and consequences of technology on the individual and society Help students make informed career decisions	Invention and Innovation † Enterprise† Information Processing Control Technology Evolution and Consequences of Technology Energy Biotechnology Technical Design and Presentation Materials & Processes
Applying technology	III & IV	10–12	Develop in-depth knowledge and experience in technology Gain experiences valuable to pursuits to further education Help students make informed career decisions. Apply problem solving skills to the solution of community, industry and other real life problems Develop an attitude that learning is a life long process	Research and Development Production Telecommunication Construction Systems Computer Integrated Manufacturing Robotics Aviation/Aerospace Electronic Communications Transportation Systems Graphic Communication

* This is not an exhaustive listing of potential courses. This list is intended to serve as examples of possible course offerings in the Technology Education Model.
† Developed courses

Presentation, Robotics, and Research and Development.

Middle and high school curricula in these areas have been developed by classroom teachers under the direction of John Hutchinson, Director of the Trenton State College Center for Technology Education. The course work is pilot tested in the classroom, refined, formalized and made available to fellow teachers. In-service training is offered to aid the practitioner in the incorporation of these Technology Education concepts into their classroom.

Impact of Technology Education

The program outlined by the Commission does not seek to toss traditional methods aside. It neither requires computers on every desk nor expensive equipment and facilities. It does, however, offer students and educators the opportunity to develop and enhance the lifelong skills of using knowledge to gain greater knowledge, of analyzing and developing questions to find answers, and of extending human capabilities to improve our way of life.

The objectives of the Commission on Technology's 1985 Blueprint for Action, the initial three-year plan, were realized. Curriculum has and continues to be developed, tested and incorporated into New Jersey classrooms. A significant number of industrial arts and other subject area teachers have taken in-service training courses in Technology Education.

There is increasing interest in integrating Technology Education with other disciplines (math, science, social studies, the arts, etc.). The public information campaign has been successful. Although Technology Education is not a household phrase there is increased public awareness and a growing consensus that Technology Education is not an educational fad but a necessity in public education as we approach the 21st Century.

A new three-year plan has been developed which continues to expand the activities of the Commission. The support of educators, business industry and government leaders has given the Commission the clout to impact policy and legislation. The Commission is proud of the support it has received from New Jersey Governor Kean. He has identified New Jersey as the "Invention State" and has endorsed the incorporation of Technology Education courses in our schools.

The Commission plans to continue its efforts toward an approved Technology Education course as a requirement for high school graduation. Other actions to be undertaken during the next three years include:

- Continuing publication, public information and related activities
- Continuing curriculum development, pilot testing and in-service training
- Recommending changes in teacher certification
- Reviewing proficiencies in Technology Education for input to State Board of Education
- Managing a system of recognition for outstanding technology students, teachers and programs
- Reviewing existing facility standards to make recommendations for change
- Selecting and monitoring technology demonstration sites
- Research and assessment activities

Chairperson George L. Fricke expresses the commitment and enthusiasm of the Commission on Technology Education for the State of New Jersey as they embark on a new three-year plan: "At the outset of this endeavor I felt it was important to incorporate Technology Education into the curriculum of our schools for the future of our state and its citizens, particularly its youth. I still feel this way—only more so."

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Making the Change

Key Issues in Moving to Technology Education

Merrill M. Oaks, DTE

The transition to technology education in our secondary schools is creating high interest across the country. According to a recent *Business Week* article, approximately 40 states are now offering some courses in technology education (Bluestone 1987). Brad Thode's advanced technology approach in Hailey, Id.; Kjell Rye's problem-solving program in Bellevue, Wash.; and Kim Durfee's Technology Lab 2000 program in Salt Lake City, Utah, are examples of programs that are captivating students and gaining the attention of parents, school and state officials, community leaders and the news media.

These programs have two things in common: they are excellent examples of technology education and they are relatively new.

The change to a curriculum that reflects technology started officially about five years ago. The last three years, however, have brought dramatic changes including:

- More than 30 states and several professional councils affiliated with the International Technology Education Association (ITEA) have changed their names to reflect technology education.
- Teacher preparation institutions, such as Kearney State College, Kearney, Nebr., have modified curriculum and facilities to exclusively reflect technology.
- Increasing numbers of states are developing technology education curriculum guides and classroom activities built around either the four major content organizers of manufacturing, communications, construction and transportation, or the broader concepts of technology.
- Current national legislation before Congress provides for regional technology education centers and funding for growth and development of technology education across the nation.
- Several states have passed technology literacy laws guaranteeing technology education for all children.

These changes are clear indicators that the transition from industrial arts to technology education is in process. Making this transition a smooth one depends in large measure on how well teachers are informed and prepared to assume their new role(s).

The purpose of this article is to identify and discuss major issues that are universally addressed by teachers and administrators involved in the change to technology education.

Initiating the Change

The ongoing changes in our society mandate that we provide students with an accurate reflection of our technological world. This can best be accomplished by acknowledging and accepting change as a continuous, positive process.

Change is frequently challenging. However, for those who have changed to technology education, the results have been well worth the effort. Increased enrollments and highly motivated students are one common expressed benefit. As another, teachers report that technology education is well-received within the school and community.

A third benefit is an opportunity to develop cooperative programming with other academic disciplines including math, science, history and social studies. This more integrated curriculum helps provide all students with requisite competency and knowledge necessary for the complex society of the 1990's and beyond.

Once the decision to change has been finalized, important issues should be identified and discussed by teachers. The following issues were identified by practicing teachers as being the most important as they began the transition process to technology education:

- Learning about technology education—How do I fit in?

The author is an associate professor in the Elementary and Secondary Education Department at Washington State University, Pullman, Wash. This is a refereed article.

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- Teacher in-service and retraining—How do I do it?
- Professional considerations—Where can I get help?
- Reviewing and selecting curriculum materials—What resources are available?
- Facility requirements—What will the new facility look like?
- Equipment requirements—What equipment is needed
- Funding—Where do we find the money?

The Steps in the Transition Process

Learning About Technology Education

Technology education as a concept is not new. Leaders in the field have discussed the concept, written about it and proposed technology-based programs for years. Technology education as conceived and used today, however, is relatively new. The process officially began several years ago when national leaders in industrial arts met to discuss a new focus for the future of the profession.

The result was the *Jackson's Mill Industrial Arts Theory* report (Hales & Snyder, 1981). An excellent beginning for developing a clear understanding of technology education starts with a review of this document. It is here that the real foundation was laid for both theory and content. The focus is on the systems approach and how the content organizers (areas) of transportation, construction, manufacturing and communication were identified and codified.

A second document helpful in understanding technology education is the *Standards for Technology Education Programs*. The Standards' definition for technology education states: (ITEA, 1985)

> Technology education is a comprehensive action based educational program concerned with technical means, their evolution, vitalization, and significance; with industry, its organization, personnel, systems, techniques, resources, and products; and their social cultural impact.

A review of the definition found in the Standards leads to a complete review of that document. Here a clear understanding of specific components and criteria of a quality program are clearly set forth.

A third highly recommended activity is the viewing and discussion of the Wisconsin Education Television Network film, *Education for a New Age* (Herbach, 1985). This series identifies the importance of education and technology and provides a means for discussing and initiating change.

Fourth, with the Wisconsin series as background, site visitations can be arranged to local advanced technology industries to establish the reality of change and importance of teaching about contemporary technological processes. Experts in the area of advanced technology and educational change can provide specific reasons for change and suggest ways to achieve those goals in education.

Fifth, a thorough review of journals and publications in the field is essential to understand what technology education is, how it has evolved and how it is important to the school curriculum. Articles from journals, including *The Technology Teacher, Technology Review, High Technology Business, Industrial Education, School Shop,* the *Journal of Epsilon Pi Tau,* and the Journal of Technology and Society provide a good beginning. A complete publications document is also available directly from ITEA, identifying a wide selection of resource readings including the Jackson's Mill and Standards documents.

Last, continued discussion on a range of technology education topics is essential for establishing a clear understanding of its mission and goals. Discussion encourages the free exchange of ideas and provides for each person's identity with the new curriculum. This personal identity is vital for full participation and support from the school and community.

Teacher In-service and Retraining

Of all essential elements to consider when making the transition to technology education, teacher retraining is one of the most important. Technology education classes typically will be staffed with former industrial arts teachers. These teachers are going to need to broaden their knowledge base, according to McCrory (1985), who indicated that technology teachers will need to have a good grasp of the physical and social sciences as well as technical skills to manage a wide variety of learning activities.

How to retrain these teachers in a relatively short period of time is the key issue. It is an issue that must be dealt with effectively if the maximum potential of technology education is to be realized. Since most currently practicing industrial arts teachers will be retrained, a maximum effort must be initiated immediately. Selected states and school districts have recently begun to think through this retraining process (Tobin, 1984).

Professional Considerations

There can be no better way of discussing issues and gaining current knowledge in technology education than by joining a state level technology education association and the International Technology Education Association (ITEA). These organizations offer members an impressive list of support services designed specifically to assist technology education teachers. State associations offer meetings, seminars, publications such as newsletters and monographs, and one or more state wide conferences throughout the year in addition to curriculum materials, promotional items, and leadership opportunities.

ITEA offers members a continuum of services including curriculum materials, a computer communications system—The Technology Link, and an excellent journal—*The Technology Teacher*, as well as a wide variety of publications. ITEA also provides members with a host of promotional items to assist teachers with public awareness of technology education.

Reviewing and Selecting Curriculum Materials

There currently exists a variety of excellent curriculum materials developed and made available by several commercial publishers and many individual states. A recommended approach is to send for and review curriculum materials available from your state, ITEA, or others—including Texas, Iowa, Idaho, Ohio, Wisconsin and New York. Contact the State Department of Education and or the State Supervisor of Technology Education Industrial Arts for information and availability.

The current list of textbooks available for technology education is growing rapidly. Publishers are recognizing the need and responding with texts in general technology, construction, manufacturing, communication, and transportation. These texts provide content and excellent ideas for classroom and laboratory activities. Many also include teachers' guides and student activity workbooks. Publishers will typically allow 30 to 60 days review of their materials free of charge. A complimentary desk copy may be available if you adopt the book(s) in technology classes.

Suggested methods for locating appropriate texts for your particular needs include: Contacting local or state vocational directors and supervisors, or contacting publishers at conferences or by mail. School librarians may also have a listing of publishers and publishers' catalogs for review.

Facility Requirements

An important issue facing prospective technology education teachers is how existing facilities can accommodate the teaching of technology subjects. It is an important question since it provides the opportunity to upgrade facilities to match new curriculum requirements.

The process starts by answering questions related to the new programs to be offered. First, will courses be offered in only one area of manufacturing, construction, communication, and transportation, or a combination of these? Is it to be a specialized "unit" facility or a more comprehensive "general" laboratory?

Once these issues are resolved, the important question of dedicated space can be decided. For example, a classroom area should be identified and planned. The laboratory itself should be planned to accommodate advanced technology equipment.

One important element is a "clean room" or one free from dust and other material producing particulates. This may be planned as part of an existing classroom or a completely separate room. Computers and certain computer-driven equipment such as computer aided design machines (CAD) must be in a clean, temperature-regulated, static-free environment. This area should also be designed to be as soundproof as possible since traditional equipment may be in operation when computer programming is simultaneously being developed.

Lighting should be adequate, with soft light preferable to harsh white. Room color should complement operations in the room. Pastel colors are preferable.

Storage facilities will most likely be modified. For example, quantities of less bulky materials such as wood and metal will be used. However, new space with adequate security must be identified for computer software and other related items. Project storage may require smaller lockable drawers or cabinets to house software, large format paper, blueprints and printouts. Large project storage areas and finishing rooms may take on a new look as the "high tech," or "clean," area. A common concern of many technology teachers is lack of adequate storage. If the opportunity to redesign a facility is presented, adequate storage should be a high priority.

Another important concept is a teaching center. Many technology teachers are requesting a center as part of facility remodeling. This center is typically a designated area, either portable or built-in, which enhances quality teaching.

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Equipped with a computer, projection devices, a writing board and other teaching aids, its purpose is to make teaching easier for the teacher and more motivating for students.

Equipment Requirements

Whether the shift to technology education occurs virtually overnight (as it did in New York) or a phase-in approach is used (as is occurring now in Washington), decisions regarding how the laboratory is equipped must be faced. The general recommendation is not to strip facilities of existing equipment. It is likely that curriculum change will occur over a period of time in which more traditional equipment will continue to be used, while new concepts, ideas and activities take shape.

A practice follow ed by many teachers is to maintain the current laboratory equipment inventory until the integration transition to technology is well under way. This provides time to make thoughtful decisions about retaining selected existing equipment.

The ultimate decision regarding appropriate equipment for a technology laboratory will be based on the age and grade level of students using the equipment, and the intended use of the facility. For example, a junior high school facility previously used primarily for woodworking will develop a new look with equipment and activities appropriate for one or more of the technology clusters. Teaching robots, bench-top computerized numerically controlled (CNC) lathes and mills, computer-aided manufacturing (CAM) simulation devices, small conveyor systems, computers with word processing, and computer-aided design (CAD) capabilities are examples of equipment typically found in this type of facility.

Secondary level facilities may be similarly equipped but higher levels of traditional equipment may be retained to accommodate both technology and vocational programs. It is important to note that much traditional equipment, including lathes, milling machines, saws, profilers, and drill presses, can be retrofitted with computerized controls for instructional purposes. This process is not excessively expensive and does reflect state-of-the-art technology.

The important issue is to recognize that substantial change in existing equipment must be made to accurately reflect a "technology education" curriculum. However, this change is frequently a gradual process recognizing that time is typically needed for increased funding, teacher retraining and curriculum development.

Funding

One concern of technology teachers is how to raise funds for their new curriculum. Technology education need not be an expensive curriculum. Budgets formerly used exclusively to purchase quantities of wood, metal, and plastics can be used for technology education items, including software, computer paper, and simulation devices. Obviously, increased funding is important and must be considered for equipment purchases such as CAD, CAM, lasers, robots, etc.

In an interview article (Almeida, 1985) on funding sources for technology education, the author identified the following sources for programs, courses and services:

- Federal support (through the Vocational Act)
- State support
- Community-based funding sources
- Private support from business and industry (an often overlooked source)

Federal Grants—Federal funding is available in the form of grants or contracts. Typically, grants will be written at the school district or state level. Most states and many local school districts have a designated person who is familiar with federal funding sources and proposal information for both grants and contracts.

State Funding—There is typically a variety of funding sources available through state offices of education. These funds may be flow-through federal money or state appropriated. Oklahoma, for example, currently funds about $27,000 for each technology education program with an additional $4,000 per year to prepare facilities and start the new program. Grants range from a few hundred dollars to over $100,000.

Mini-grants ranging from $500 up to $6,000 are currently one popular method of dividing available funds to reach a maximum number of programs.

Specified states have approved industrial arts (technology education) for pre-vocational funds as part of the 1976 Vocational Act (amendments). Funding in these states is available for classes meeting the "pre-vocational" criteria. Check with local or state technology education supervisors and vocational directors for availability of this program for technology classes.

Community Funding—A third funding source, which in some states can be a tremendous boost to technology education programs, is local school levies or bond issues. One local school district in Washington State recently passed a one million dollar bond exclusively for technology education use. Teachers should work directly with school and district administrators to explore this important funding source.

Private Funding—A fourth, often untapped funding source, is that of private citizens, industries, or business firms. Endowment funds, material or equipment grants, trusts, estates, and scholarships are but a few of the opportunities available to local school systems.

Often, in the case of equipment or other tangible goods, firms can and will make an "in-kind" donation, that is, donate equipment, materials or other items as tax write-offs. One school was recently given an industrial robot, a completely automated microfiche processing center, a numerical-control milling machine, and a research vehicle. All in one year! This source holds tremendous potential for programs which are sharply focused on "advanced technology" and technological literacy. The key is to provide strong evidence to the potential donor of how their donation will directly benefit the program and community.

Summary

Technological literacy is no buzz term. It represents essential skills that we as technology educators have the opportunity and responsibility to deliver.

This article has identified and discussed eight key issues important to educators as they prepare for the transition to delivery of technology education. These issues range from learning about technology education to facility requirements for new programs. Addressing these issues immediately will assure that teachers are prepared and facilities equipped for the new curriculum.

The change to technology education is underway. Several states have made dramatic progress, others are initiating pilot programs, while others are currently planning for the transition. We must all move quickly to ensure that our programs reflect the knowledge and skills of the 1990's and beyond.

16

It Wouldn't Work With My Students

James J. Mooney

Are we different? The new Technology Education in the secondary school yields a number of reactions from Technology Education teachers. It is not uncommon to hear "it wouldn't work with my students," or "it is not possible in my school," or "my district would not approve that idea." The assumption is that there is something unusual about our students, school, or district, found in no other place.

No one questions that students are unique, that schools and their program have their own characteristic, and that districts may have special problems. But is this what is holding back the teacher from teaching technology? Or is it something different?

We have so much to discover about learning and behavior but research has provided us with information regarding students. We know that all students have wants and desires. We know they are interested and curious about things around them. They want to know how things work and why they perform. In essence, they are seeking knowledge in one form or another.

Students are constantly seeking identity. They want to know their strengths, be aware of their weaknesses, and understand how they can become a capable, contributing individual. They need to accept themselves and be accepted by others. Their interest in learning is rapid and sustaining when challenged.

These characteristics are the same whether the students are from the inner city or the suburbs; whether they come from parents of substantial wealth or poor homes; whether the student is a slow learner or high achiever. What this means is that your students are essentially no different from other students. What may be different is what we do as teachers. Maybe we lecture too much when technology is action. Maybe we have forgotten that activities will teach what we lecture about faster, and it will be retained longer.

Possibly our image gets in the way. That is, our tool skills are clouding the issue of studying systems, solving problems, and making decisions with new tools that are showing up and will dominate students of the 21st century. As hard as it may seem, students may not embrace the same skills we have, but will need skills nevertheless.

It also may be that students participating in Technology Education are not slow but rather a type that wants to do things, to wrestle with a problem, to discover first hand a solution to a problem confronting them and society. They are the individuals with the qualities that will allow them to become the technologist of the future.

Common Phrases?

A common problem recently cited is the lack of students to fill Technology Education classes. This may be true because the total population of the school has dropped, having little to do with the worth of technology courses. Now, for the first time, we have the opportunity to actually do something for those slower students by having smaller class sizes. More attention can be devoted to students that need extra help or students that have different styles of learning. For years, schools have pleaded for smaller classes, for different mixes in classes, for the opportunity to do things never possible when schools were overcrowded.

Rather than see small classes become a detriment, we need to see them as new opportunity for creative teaching. It may be interdisciplinary teaching or special activities. It may be experimental programs, courses, or activities in or outside the school. But what is important is that we, as Technology Education teachers, think creatively. We must become involved and go to our administrator with ideas for new and different approaches in teaching. It just may be that the administrator has been waiting for some new challenging program that he or she could become excited about. But it will not happen, unless we present the idea.

Another common phrase is, "it is not possible to teach Technology Education in my school because more students are going to college." We hope more students are going to college for they will need all

The author is a professor in the Department of Technology at the State University College at Buffalo. This article is reprinted from the Technology Educator.

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the education obtainable to adequately function with modern day technology. But what is a student who only knows something but cannot do anything?

It is not fair to provide only half an education for students that go on to college. Technology is not selective. It is not the product of only craftsmen. It affects every individual whether they are a doctor, teacher, engineer, plumber, sweeper, or banker. But it is technology that must be taught and not a craft program designed for another time. It is decision-making, problem-solving subject matter that needs to be taught. And this approach, must be sold to those making decisions in our school.

Still, another difficulty faced by teachers is the problem of scheduling; to find time for Technology Education in the secondary school. In this day and age the problem of scheduling ought not to be an issue, for the computer will work 24 hours a day without a coffee break. It can produce numerous schedules and variations at a speed unheard of a few years ago. What may have to take place, is that we take the time to suggest ideas, and work with guidance personnel in scheduling students.

Why is it possible for one school to have a number of classes in Technology Education and others, find difficulty in providing technology education to their students? What is it that some schools do that seem to work for the benefit of our students and others cannot do? We need to find out. We need to do what they do if it frees up the schedule for Technology Education.

"My district would not approve," is expressed by many a Technology Education teacher. But many districts do approve. They approve of programs that reflect a present and (more important future) commitment of understanding the technology. The district, and the board representing the district, is concerned as we are and recognizes the importance of technology and understanding its impact on all of society.

But they must be convinced that we are a program worthy of the 21st century, not the 19th and 20th century. Somehow, teachers that come to boards of education with a well worked out documented proposal are granted their request. It means work on our part but everyone looks at a well organized proposal with favor when costs, goals, and results are spelled out. Those that take the time to research their request and coach it in the understanding of the board or administrator are ahead of many other requests made to the district.

It might be that our proposal is coupled with science, history, or mathematics. There are so many things in other subject areas that we can amplify and expand upon. We can take the science of light into laser technology; energy understanding into energy conversion technology; electrical laws into computer technology; and the concept of systems into realistic situations. We can show how inventions, developments, and products of history have given us the technology related to a high standard of living. Numbers and tolerance can become real to the student through systems of control, measurement, and layout.

A Different Approach

It would seem that the learning and development of our students is not any different from students in other schools. The basic operation of our school may not be much different from other schools. Nor does our district and the board of education have less concern for technology than other districts. If there is any relevance in this, than how come one district may have secondary courses in technology with good enrollments and the opportunity to obtain new equipment and another does not? Is it because the teacher is at fault? Is it because we still see ourselves as shop teachers; as teachers of woodworking, metalworking, and drawing? Is it because we see our program as only for the slow, the average, or the below average students?

It may be that many of us were programmed for a different time and a different emphasis. But more important, we have the opportunity to overcome our past, to leap frog into the future. We need to reverse the negative attitude and become the positive leader we are capable of being. We need to develop some bold programs, some new, never-tried before approaches, and present this to those having the responsibility to make changes.

It might be the time to forget tinkering but to leap into the 21st century. It might be a well-thought out program that is not scheduled in the normal way. It may be interdisciplinary in nature where we combine the best of other subjects. It may be a program outside the school walls. It could take advantage of skills parents have, working as a team in teaching technology. Doctors, with their work in biotechnology, could contribute. Engineers could help in bridge and tower construction. Energy experts could be directly involved in our classes.

All of this must be boldly planned. It must be creative and spark the interest of other school personnel. Society has placed its hopes on technology as the solver of many of our problems. Who better than us, can carry the message to our school and its board of education? Rather than feel we are in trouble in the secondary school, why not look at it as the greatest opportunity in the last 50 years we have had to be the leader in our school? We owe it to our students.

Impact of Technology

One often overlooked area in the Technology Education curriculum is the impact of technology on our environment, society and lifestyles. This publication assists teachers in teaching about the technical, financial, environmental, and social impacts of the technological choices our society has made.

Jerry P. Balistreri. 32 pages. 1987

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The Woodlands, Texas

Larry J. McHaney and Jerry Bernhardt

A simple discovery caused some radical changes and opened incredible new doors for technology education at McCullough High School. The school's first academic pep rally; visits from and discussions with Congressmen, Senators, state officials, astronauts, influential community leaders, dignitaries, newspapers and television reporters; students excited about schools; and increased enrollment for next year represent only a few of the effects felt so far. What we discovered was how to unleash the potential of Technology Education through what we call the "Central Project" and "Component Project."

In recent years a great number of people have cried out for some type of educational reform. A wide range of theories have emerged, but few people have found a way to effectively put these theories into practice in the classroom. At the same time, the change from Industrial Arts to Technology Education has left many teachers asking, "do I implement the new curriculum? What effect will these new educational theories have on Technology Education? and our jobs?

In an attempt to increase the academic nature of courses and implement Technology Education, some schools have discarded much or all of their traditional equipment and spent thousands, even millions, of dollars to purchase new "high tech" equipment for their programs. However, most of us work in school district which cannot afford to invest that amount of money on our programs. So how can the rest of us truly teach technology and still survive the trend toward an "intellectual" focus in education?

We at McCullough High School feel that we have found a way. We realized that Technology Education requires a change in philosophy more than a change of equipment. This article attempts to show teachers how the "central project" is a practical model which can be used to modify existing curriculum content for implementing Technology Education, while, at the same time, incorporating many of the theories and accomplishing many of the goals set by some of the best known leaders in education reform.

"We realized that Technology Education requires a change in philosophy more than a change of equipment."

Trends in Education Reform

The trends in education reform take many shapes, but the emphasis is fairly consistent. Schools need to become intellectual incubators where students "learn how to learn and thus to teach themselves" (Sizer, 1986). According to Adler, students need the ability to learn to help them grow mentally, morally, and spiritually; to become good citizens and to earn a living (1982, pp. 16–17). Our fast changing world has created a huge, ever growing, ever changing knowledge base. So that even if schools could afford to constantly update their equipment and stay on the cutting edge of technology, they still could not prepare students for the dynamic and unpredictable job market of tomorrow. High school can no longer attempt to be comprehensive (Sizer, 1986) and provide students with all of the knowledge they need to live productive lives. Students must leave high school equipper with the ability and desire to become life-long learners.

The Role of Technology Education

Even though other departments in the school could direct the central project, we feel that the most logical and best suited department for the job is Technology Education. Technology is the practical application of science, math and language to improve the quality of life. Technology had and continues to affect our history, our society, our political structure, our health and almost every part of our lives.

Many of the proponents of education reform understand the profound impact of technology on our world and many think that all students need to learn about technology (Bover, 1983, pp. 109–111). Technology education courses should allow the practical application of all subject matter. A well planned central project provides one of the best ways to make technology education a vital part of a

The authors are both technology teachers at McCullough High School, Conroe, Tex.

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school which helps students to learn how to learn.

What is a Central Project?

The idea of a central project is not new; in fact it is quite old. Frank White quotes Edgar Mitchell's Institute of Noetic Sciences to point out several historical central projects including the Egyptian pyramids, Gothic cathedrals and, more recently, NASA's Apollo project. He goes on to say that central projects are a "means of focusing the energies of a population during an evolutionary transition to a higher level of culture" (1987). In schools, a central project is a topic around which students, teachers, administrators and the community as a team focus their energies.

Teacher can plan a portion of their curriculum to correspond with the central project theme and guide students toward the development of at least part of the project. All of education can benefit by understanding their relationship to a school-wide central project (Figure 1).

Project Space Station was born when second-year Architecture students wanted to try something different and eventually grew to include over 400 students. The finished station awaits its "astronauts" and their three-day mission.

What is a Component Project?

All forms of business and industry are actually orchestrations of component projects which are brought together to form a central project which they hope will be a salable project. Much like industrial projects, central projects are usually too large and too intricate for any one person or class to complete, and must be broken down into smaller individual or group projects that we call "component projects." Many component projects can be divided again into subcomponents. Students learn the difficulties of coordinating, communicating and consolidating their efforts in a complex organization.

McCullough's Central Project Project Space Station

The project started when second year Architecture students, tired of drawing typical residential and commercial buildings, wanted to try something different. Given the problem description, students works enthusiastically to research, design and build a habitat which would sustain four people in an outer space simulation for 72 hours then carry out the three-day missions, wrapping it up with a final evaluation of the project. Thus was born Project Space Station.

A few days later, the second-year Technical Drawing students asked how they could get involved. The Space Station needed an Orbital Maneuvering Vehicle (OMV) with mechanical or robotic arms to launch satellites and do repairs so the Technical Drafting class assumed the responsibility of designing and building it. They began to work with the Metal Technology students who helped to develop and produce components for the OMV and its arms. Wood Technology students development and produced containers to hold experiments, food and clothing. They also produced plaques that we gave to our major contributors.

Almost every student enrolled in a Technology course got involved in the project. Figure 2 shows some of the component projects that made up Project Space Station and how they relate to our new Technology Education curriculum.

We found that students learn, "under the right conditions, not only to accept but to seek responsibility" (Peters & Waterman, 1982) when students who had never taken a technology course came to us asking how they could get involved.

As the project continues to grow, we began to realize that not only could students from other courses get involved, but we saw how much we needed the talents of these students and teachers. We had help from students and teachers representing almost every group in the school. In all about 400 students worked on the many components of the Space Station. We started the McCullough Students Astronauts club (McCSA) to help consolidate the great variety of students.

Some departments integrated the project into their curriculum be developing, submitting and monitoring experiments which the crew performed during the mission. The food services classes research space food and then precooked and packaged all the meals for the astronauts. The Art Department decorated the commons area with creative space art. The math classes helped with water volume, air replacement and weight calculations and also prepared an experiment determining astronauts response time that was performed during the actual mission. Physics classes helped build robotic arms, language arts students prepared the astronauts for all of the writing that would be required, and the social studies classes took an active part in soliciting support and participation from local, state and national elected officials.

Individuals and companies in the community pitched in to support the project. Some donated money, materials or discounts on needed items. Others gave their time and expertise which lead to professional mentorships and, even, job opportunities for some students.

One mentor was a doctor who worked for NASA during the Apollo missions. He read about our project in the *Houston Chronicle* and called us. He invited a couple of technology education students and a couple medical careers club students (who were developing a medical experiment for the mission) to come to his laboratory at the University of Health

Science Center so he could show them the proper way to conduct the experiment. The space station was set up and the mission carried out on the stage in the commons area of the school for everyone to see. At the blast-off celebration (pep rally), the whole school and many families and people from the community packed the gymnasium as the McCSA students entered like the football team and set in the seats of honor. Congressman Joe Barton and Astronaut Joe Allen encouraged and praised the students, the school and the community for their vision to attempt such a project and their perseverance to complete it.

"One student said, 'This has been the neatest experience I've ever had in school.' "

The first night of the mission we held a Space Station extravaganza to give more people in the community a chance to the see the mission in progress. The school jazz band and choir performed to open the event. Later, Senator Phil Gramm called from Washington; John Trebes, director of the space station mock-up facilities and Dr. Larry Bell, president and founder of the Sasakawa International Center for Space Architecture at the University of Houston spoke to the audience of 1,200. The crew performed experiments as the crowd watched by video camera and then launched a satellite (a helium balloon) with a peace message especially written for the occasion by elementary school children.

The mission was a great success because of the hard work and cooperation of all of the students and teachers in the school, a tolerant and progressive administration and tremendous community support. Each student involved came away with the educational experience of a lifetime. As one of our astronauts put it, "this has been the neatest experience I've ever had in school."

Criteria for a Successful Central Project

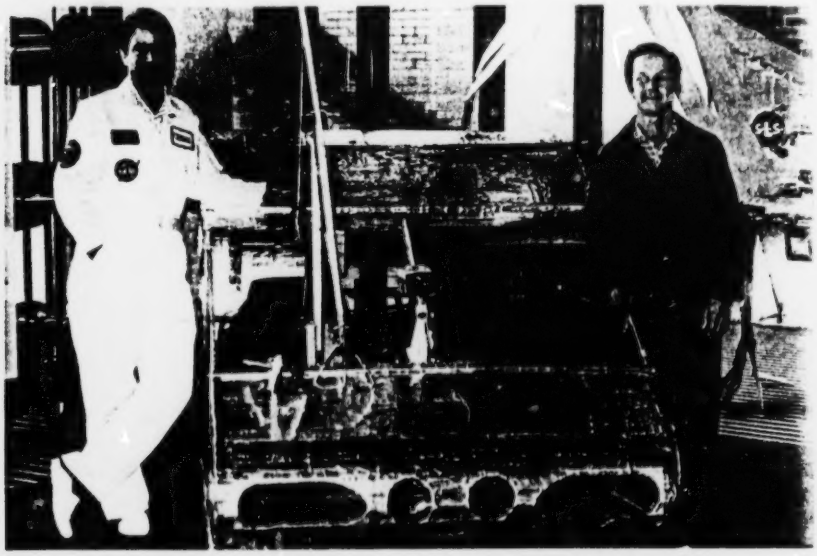
An idea for a central project, in order to be successful, should meet certain criteria:

- Stimulate interest
- Incorporate the community and its available resources
- Be meaningful and realistic
- Be interdisciplinary
- Be made up of component projects
- Encourage creativity
- Provide recognition in the school and community

Stimulate Interest

A recent survey of workers in America asked them to rank, in order of importance, the ten aspects of their jobs that keep them motivated. Surprisingly, "interesting work" topped the list (Kovach, 1987). Students in America, like the workers in the survey, tire of being taught the same old thing in the same old way. They complain that school is boring and worthless. Thus, Thomas McDaniel (1985) made his first commandment of student motivation, "Thou shalt build an interesting curriculum," to insure the central project's success, it must capture the imagination and interest of students, faculty, administration and the community.

At McCullough High School, we chose a space-related project because we felt that in our community it would be the best topic to stimulate the interest required.



The authors pose with the OMV—Orbital Maneuvering Vehicle, also researched and built as part of the central project.

Not unlike young people of the early 1800's who dreamed about the Western frontier, a great number of today's student are fascinated with and drawn to their frontier: Space. With the achievement of their century in mind today's students know that they will be the engineers, architects, designers, scientists and technicians of the 21st century—a century that will no doubt see the exploration and colonization of many parts of our solar system. Astronauts are still thought of as heroes in America and the space program continues to be looked upon with awe by the general public: therefore we feel that programs which deal with space will generate a great deal of excitement among students, faculty administration and civic leaders in almost any community.

Incorporate the Community and its Available Resources

The future of our country and our way of life depends on the quality of education our student receive (Alder, 1982). Therefore, business, community and educational leaders need to realize their interdependence and work together to make education the responsibility of the entire community, not just a handful of paid professionals. Too often, schools become isolated entities and self-contained communities (McDonald, 1986). The importance of community involvement in schools is well documented. "The growing thriving partnership between public education and the private sector," says Carolyn Warner, "is the most important partnership in America" (Teacher & Instructor, 1986). These partnerships help students fell like a part of the community (Boyer, 1985) while providing the school greating access to technical, financial and political support (Wilson & Rossman, 1986). A good central project can help build lasting partnerships for the school and establish mentorships between professionals in the community and students.

As discussed earlier, space projects appeal to all types of people. Bring located just north of Houston, the Woodlands and McCullough High School are close enough to make use of the Johnson Space Center as a resource for information and field trips. Our project was well timed to elicit great community support because at this time there is also much hope that the development of NASA's Space Station will help revive Houston's economy.

During the course of the project, many professionals, including doctors, engineers, architects, university professors, video experts and more gave their time, energies, equipment expertise, and sometimes money to help our student succeed.

Businesses in the community helped by provided supplies and materials free of charge or at tremendous discounts. Research shows that people who are involved with schools "perceive them more favorable" (Wilson & Rossman, 1986). Those involved in Project Space Station think highly of McCullough High School. Other schools may be located in areas in which other topics for central projects may be more applicable or generate more interest and participation than space projects. Consider the needs, interests and resources of the community, then choose a project which is best suited for your students and your community.

Meaningful and Realistic

Another key factor is that the project not only be studied and designed on paper, but it must be used and tested for the whole school and community to see. "All genuine learning is active, not passive" (Adler, p. 50), therefore, the motto for Project Space Station was: "I hear and I forget, I see and I remember, I do and I understand."

Students want to see that their work in school is not in vain. Students always ask, "Why are we learning this? How will it ever be of any use to me?" The central project answers those questions. A creative teacher can in some way, link almost every assignment to the central project or a component project.

Students then see how what they are learning relates to the "real world." The project itself, the work that is done and the way in which it is done, creates a learning environment which is very similar to industrial practices.

Interdisciplinary

As discussed earlier, central projects can and should involve the whole school.

"Student questions should be answered with probing questions or one of our favorite responses 'I don't know. What have you found?'"

The central project model provides students with the missing step in the education process by giving them the rare opportunity to synthesize and apply a vast array of knowledge from different disciplines throughout their educational careers into significant and meaningful practical applications. Students learn how

different subjects within the school relate to and depend on each other. Interdisciplinary design teams can be formed which will allow students to learn from each other as they work together and pool their knowledge to solve design problems. To get other teachers involved, the project directors should point out the great number of positive aspects of the central project and help them understand how the project relates to their field. The expertise of teachers and students from other departments may be critical to some central projects.

Sizer, Adler, Boyer and many others believe that the strict departmentalization of the high school must be done away with to help students understand the interconnections between subjects and between school and the rest of the world. In innovative schools, the central project can be the stepping stone for experimenting with this theory.

On the other hand, the existing curriculum does not necessarily have to change. What changes is that teachers and students are asked to develop their assignments and projects around a specific central theme. Research papers, math projects, science experiments, social studies activities, art, drama, and musical presentations, and vocational projects are all developed around the central project.

Everyone in the school is aware of and involved in the project. Halls, bulletin boards, classrooms, and the cafeteria are all decorated and display information related to the project.

Excitement and commitment build throughout the community. As more teachers and students get involved in the project, community and parent support will grow, which should increase the likelihood of the project's success.

Component Projects

The next criteria is that the central project consists of a number of component projects. Component projects allow students to personalize their educational experience by choosing a specific area of the project which interest them. Students gain mastery of a specific topic and display their knowledge in an observable behavior: the completion and integration of their component project with the central project.

Many proponents of education reform want to require students to demonstrate their achievement in order to be eligible for a high school diploma. The successful completion of a component project could be used as part or all of a required "Senior Project" (Boyer, 1983) or "Student Exhibition" (Sizer, 1986).

The number of component projects will depend on the number of students involved and the central project itself.

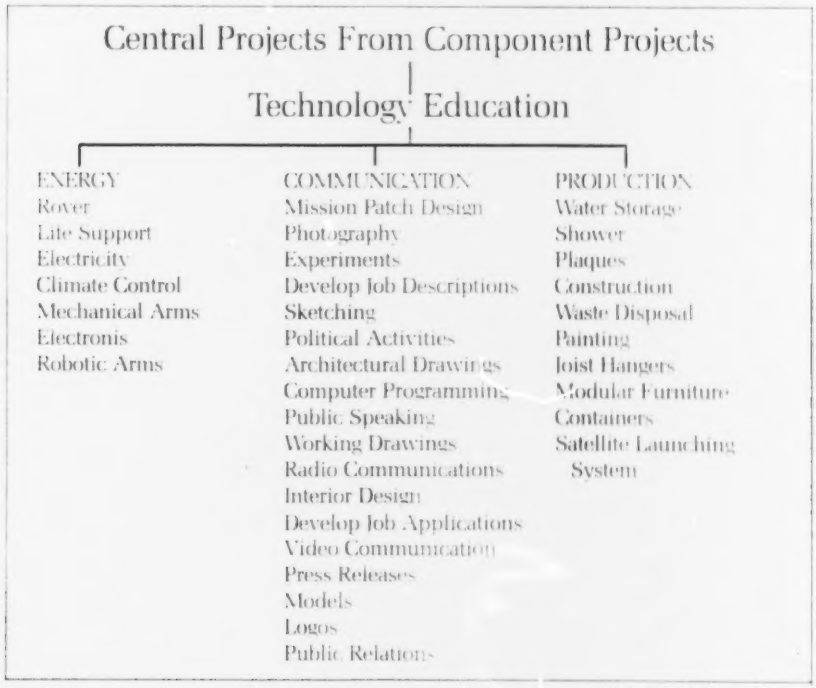


FIGURE 2
Central projects from component projects

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Even a small central project can have a great number of component projects. It is important that each student in the class get involved in some capacity. At McCullough, we found that even lower-achieving students, once involved, became very excited about finding a place to fit in. If, by chance, there are not enough component projects to go around, different design teams can be formed to work on the same problem much like industries compete.

Creativity

Each component project should be posed to the students in the form of an open-minded problem. We agree with Peters and Waterman (1982) that "the capacity to exercise a relatively high degree of imagination, ingenuity, and creativity in the solution of organizational problems is widely, not narrowly, distributed in the population."

Teachers should give the students a short list of design criteria and try very hard not to limit creativity. A well written component project problem description will not suggest any methods, materials or lead students toward any specific solution to the design problem. Students must actively seek the skills and knowledge needed to successfully meet the criteria.

Following this process will stimulate students to become more responsible for their own education as advocated by many leaders in education reform (Bover, 1983, p. 129). As Adler suggests, teachers are no longer the "knowers who attempt to put the knowledge they have in their minds into the minds of their pupils" (1982, p. 50). Teachers may leave the didactic form of teaching and move into Adler's second and third column which employ the pedagogues of coaching and Socratic dialog.

Student questions should be answered with probing questions or one of our favorite responses "I don't know. What have you found?" At first students will dislike these teaching styles because most are accustom to getting immediate answers. These methods of teaching are powerful tools which help students to develop critical thinking and problem-solving skills. Students learn to follow the steps of the design process and to use the scientific method in order to develop projects.

Recognition

The last but possibly most crucial element to the success of the central project model is recognition. In the survey of worker motivation mentioned above, full appreciation of work done received the second highest rating, right behind interesting work (Kovach, 1987). Students, like anyone else, want the recognition from their peers, teachers, family, and community members.

Unlike previous regional and state competitors, McCSA students received a great deal of attention for their accomplishment through the pep rally, extravaganza, and media coverage. Everyone in the school knew about the project and who had worked on it. Knowing that their component project will actually be used as a part of the central project and will be seen by their friends and family, students are motivated to do their very best.

"These methods of teaching are powerful tools which help students to develop critical thinking and problem-solving skills."

They also realize that they are part of a team in which others are depending on them. Being a part of a team or group is extremely important to students. Each student involved received a certain amount of notoriety while experiencing the feelings of ownership that come from creating something new while they learn how to work in a team situation which is widely utilized in industry.

Summary

The central project is an excellent model for implementing Technology Education and current educational theories. McCullough's Project Space Station was a great success because it was the right central project for that particular time and community. The space station and its components allowed students to pool information and apply their knowledge from various subjects and experiences while working on a meaningful and realistic project. The pep rally and extravaganza gave students the recognition they deserved for their hard work and permitted the community more access to school activities.

Our central project not only got students throughout the school involved along with their parents and many members of the community, but it actually got them interested and excited about what was going on at school. Any well chosen central project can help schools implement prominent educational theories and make Technology Education a reality while using existing equipment and making relatively small changes to the existing curriculum.

The central project a practical model which can put technology education and technology educators at the forefront of education reform. We are confident that the implementation of the central project model can make the change to technology education an exciting and very rewarding experience for students and teachers throughout the school and the community.

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Microfiche copies of ERIC documents are available through FEIS. To order these microfiche documents, use the order number found in the "Availability" field of certain entries. Microfiche documents may be ordered at a cost of 60 cents per sheet. Each sheet contains up to ninety-six pages of printed copy.

TITLE ***Alabama Course of Study for Industrial Arts-Technology Education.***

DATE 1984

AVAILABILITY Loan 2 weeks. Librarian, Southeast Curriculum Coordination Network, PO Drawer DX, Mississippi State, MS 39762, (601) 325-2510.

ANNOTATION Not available.

FORMAT Teacher Guide; Competency-based; Behavioral Objectives; 121p.

TITLE **"Artificial Intelligence: Its Future in Technology Education."**

AUTHOR Roth, Gene L.

JOURNAL *Journal of Epsilon Pi Tau*; v13 n2 p47-50 Sum-Fall 1987

ANNOTATION Defines artifical intelligence, categorizes the components of expert systems and natural language, and discusses the applications and impact on technology education. (SK)

TITLE **"Building a Positive Image."**

AUTHOR Betts, M. Roger; And Others

JOURNAL *Technology Teacher*; v48 n4 p27-30 Jan 1989

ANNOTATION The authors demonstrate how technology education teachers can improve the image of their programs. Topics include ideas to improve (1) self-image, (2) professional image, (3) the technology program, (4) image with the students, and (5) image with the administration. (CH)

TITLE ***Construction Systems. Grades 9-10. Course #8116 (Semester). Technology Education Course Guide. Industrial Arts/Technology Education.***

DATE 1988

AVAILABILITY For a microfiche copy of this document, order ED291930 from FEIS.

ANNOTATION This guide is intended for use in teaching a course in construction systems. The course, which is intended for students in grades 9 and 10, examines construction technology in terms of a sequential process that includes the planning, building, and servicing of structures. The first two sections discuss the guide's development within the framework of North Carolina's efforts to improve technological literacy and the guide's place as part of an instructional system. A list of the course's major objectives and a course outline are provided next. The remainder of the guide consists of learning modules on the following topics: understanding the different purposes and types of construction technology, starting construction projects, designing a project, preparing to build, setting foundations, building superstructures, installing mechanical systems, finishing the project, and servicing the project. Each module includes information about the length of time needed to complete the module, an introduction to the instructional content to be covered in class, performance objectives, a day-by-day outline of student learning activities, related diagrams and drawings, and lists of suggested textbooks and references. (MN)

FORMAT Teacher Guide; 105p.

TITLE ***Curriculum Guide for Drafting Communication in Technology Education.***

DATE 1988

AVAILABILITY Loan 2-4 weeks. Northeast Curriculum Coordination Center, New Jersey State Department of Education, Division of Vocational Education, Crest Way, Aberdeen, NJ 07747, (201) 290-1900.

ANNOTATION This guide was designed for drafting communications teachers. It highlights units to be covered in introductory, intermediate, and advanced levels of drafting. Each unit includes performance objectives, learning experiences and competencies. A unit on CAD encourages its use as an additional drawing tool.

FORMAT Curriculum Guide; Teacher Guide; Behavioral Objectives; 92p.

TITLE ***Curriculum Guide for Electronics in Technology Education.***

DATE 1988

AVAILABILITY Loan 2-4 weeks. Northeast Curriculum Coordination Center, New Jersey State Department of Education, Division of Vocational Education, Crest Way, Aberdeen, NJ 07747, (201) 290-1900.

ANNOTATION This reference guide helps educators research and prepare for teaching electronics. Each unit includes competencies and unit outlines that include the following: Theory of Matter; Safety; Direct Current; Magnetism; Electromagnetism; Sources of Electricity; Alternating Current; Inductance; Transformers; Capacitance; RCL Circuits; Basic Semiconductors; Power Supplies; Transistor and Operational Amplifiers; Electronic Instruments; Electronic Assembly Methods; Electronic Wiring Symbols; Digital Integrated Circuits; Radio Receiver and Transmitter; Computer Theory.

FORMAT Curriculum Guide; Teacher Guide; Behavioral Objectives; 72p.

TITLE **"Free and Inexpensive Public Domain Software: Resources for Technology Education."**

AUTHOR Schack, Mark A.

JOURNAL *Technology Teacher*; v47 n4 p21-23 Jan 1988

ANNOTATION Discusses public domain software and how to obtain it. Lists mail order and on-line sources of free or inexpensive public domain software. (CH)

TITLE ***The Illinois Plan for Industrial Technology Education: An Implementation Guide.***

DATE 1987

DEVELOPER Illinois State Board of Education, Springfield. Dept. of Adult, Vocational and Technical Education.

AVAILABILITY For a microfiche copy of this document, order ED296091 from FEIS.

ANNOTATION This guide is intended to assist administrators, curriculum directors, and teachers throughout Illinois in assessing and revising their current industrial technology education programs. The first section discusses the rationale behind the Illinois state plan for industrial technology education and lists the program's overall goals and objectives. The Illinois state plan for technology education, beginning at the elementary school level and proceeding through the middle school level to high school, vocational center, and community college and university programs, is outlined. The next section contains a more detailed description of the program of technological studies that has been planned for grades K-5. The next three sections detail the following levels in the Illinois program: exploring industry and its technologies (grades 6-8), orientation to industrial technologies (grades 9-10), and preparation programs, which focus on preparing either students who intend to seek postsecondary training in a technical field or students who wish to become gainfully employed or

advance in an industrial-related occupation (grades 11 through adult). The seventh section presents step-by-step guidelines for implementing the state plan, beginning with deciding whether or not to adopt the program model, comparing an existing program with the model, and developing a program improvement plan. A section describing various types of program development resources concludes the guide. (MN).

FORMAT: Teacher Guide, 20p.

TITLE: ***Industrial Arts-Technology Education Cluster Curriculum Activities.***

DATE: 1984.

AVAILABILITY: Loan 4 weeks. Terry Richardson. Industrial Technologies, Northern State College, Aberdeen, SD 57401. (605) 622-2571.

ANNOTATION: Not available.

FORMAT: Curriculum Guide; Teacher Guide; Reference Material; Learning Module; Behavioral Objective; Slides; 133p.

TITLE: ***Industrial Arts-Technology Education Curriculum Framework.***

DATE: 1986.

AVAILABILITY: Loan 4 weeks. Librarian, Southeast Curriculum Coordination Network, PO Drawer DX, Mississippi State, MS 39762. (601) 325-2510.

ANNOTATION: Not available.

FORMAT: Curriculum Guide; Competency-based; 32p.

TITLE: ***Industrial Technology Education Workshop Units.***

DATE: 1987.

AVAILABILITY: Loan 4 weeks. Nebraska Vocational Curriculum Resource Center, WC209, West Campus—Kearney State College, Kearney, NE 68849. (308) 234-8462.

ANNOTATION: Units: Research and Development, Materials Conditioning, Introduction to Manufacturing, Marketing, Sales and Distribution, Research and Advertisement, Manufacturing Technology, Raw Materials, Computer-Assisted-Manufacturing, Production, Assembly Processes, Separating Processes.

FORMAT: Curriculum Guide.

TITLE: **"Integrated Mathematics, Science and Technology Education: Opening Doors and Opening Minds."**

AUTHOR: Selby, Cecily Cannan.

JOURNAL: *Technology Teacher;* v47 n5 p3-5 Feb 1988.

ANNOTATION: The author argues that instruction in technology in elementary and secondary school must be integrated with instruction in mathematics and science. She states that educational objectives must be updated to make them relevant to students and teachers and presents her vision of technology. (CH).

TITLE: **"A Leadership Model for Implementing Technology Education."**

AUTHOR: Wenig, Robert E.

JOURNAL: *Journal of Epsilon Pi Tau;* v14 n1 p16-24 Win-Spr 1988.

ANNOTATION: The eight-step leadership model for implementing technology education, presented here, is one in which leaders use the principles and practices of individual and organizational transformation. (JOW).

TITLE: **"Lingering Concerns about Technology Education."**

AUTHOR: Johnson, Charles D.; Betts, M. Roger.

JOURNAL: *Technology Teacher;* v48 n5 p23-26 Feb 1989.

ANNOTATION: Some typical teacher concerns about technology education are explored. Answers reflect the belief that implementing technology education does not require entirely new instruction methods. Concerns explored include (1) use of the project method, (2) specialized equipment, (3) problem-solving, (4) needs of special students, and (5) teacher skills. (CH).

TITLE: **"Mathematics in Technology Education: The Concepts to Math Approach."**

AUTHOR: Haynie, William J., III.

JOURNAL: *Technology Teacher;* v48 n6 p11-14 Mar 1989.

ANNOTATION: The author reports research findings on the approaches used to teach mathematical concepts in technology education. Appropriate methods of teaching mathematically based concepts are recommended and discussed, and curriculum materials that employ these approaches are introduced. Findings concerning receptivity among teachers to the recommended techniques are discussed. (CH).

TITLE: **"Production Reconsidered: Implications for Technology Education."**

AUTHOR: Pytlik, Edward C.; Sinn, John W.

JOURNAL: *Journal of Epsilon Pi Tau;* v11 n1-2 p13-25 Win-Spr Sum-Fall 1985.

ANNOTATION: A philosophical concept of production technology is proposed which complements the basic underlying philosophy of technology education. It is based on the combined definition of production and technology, which necessitated the restructuring and expansion of the traditional structure into five divisions: harvesting, processing, manufacturing, construction, and service. (CT).

TITLE: **"The Role of Industrial Arts/Technology Education for Student Development in Mathematics, Science, and Other School Subjects."**

AUTHOR: Maley, Donald.

JOURNAL: *Technology Teacher;* v44 n2 p3-6 Nov 1984.

ANNOTATION: Points out how the study of technology infuses broad areas of the curriculum, particularly mathematics and science. Advocates industrial arts as a center for holistic learning in the secondary school curriculum. (SK).

TITLE: ***Special Needs Guide for Technology Education.***

DATE: 1986.

AUTHOR: Buffer, James J., Jr.; Scott, Michael L.

AVAILABILITY: For a microfiche copy of this document, order ED299781 from FEIS.

ANNOTATION: Children and adults with hearing or visual impairments, physical impairments, learning and behavioral disorders, superior intellectual functioning, and limited intellectual potential can all benefit from technological education which includes industrial arts and related vocational subjects. This guide aims to assist technology educators in preparing instructional activities that are responsive to the unique characteristics of learners with special needs. It provides an understanding of special needs learners and their unique learning/behavioral characteristics. Topics covered include: identification of special needs

learners, the importance of technological literacy for these learners, their diverse learning styles, contributions of technology education to human development, adaptation of instructional practices to special needs youth, vocational evaluation/assessment, and identification and use of resources to facilitate instruction. Appendices include a list of organizational resources and a list of technology education standards relating to special needs. (JDD)

FORMAT: Guide, 35p.

TITLE: **"Teaching Concepts: A Challenge for Technology Educators."**

AUTHOR: Wescott, J. W.

JOURNAL: *Technology Teacher*; v48 n1 p29-32 Sep 1988.

ANNOTATION: The author defines the term *concept* as it applies to technology education and reviews the research on the teaching of concepts. Guidelines for the teaching of technical concepts are presented. (CH)

TITLE: ***Technological Literacy: The Roles of Practical Arts and Vocational Education. Proceedings from an International Symposium on Technological Literacy (Columbus, Ohio, May 13-15, 1987).***

DATE: 1987.

AUTHOR: Blankenbaker, E. Keith, Ed.; Miller, Aaron J., Ed.

AVAILABILITY: For a microfiche copy of this document, order ED291956 from FEIS.

ANNOTATION: The following papers are included: "Technological Literacy: What? Why? For Whom?" (Kranzberg); "Technilterate vs. Technilliterate (There's an L of a Difference)" (Stone); "International Perspectives on Technological Literacy" (Dyrenfurth); "Technology and the Liberal Arts: Are We Producing Technopeasants?" (Brockway); "Study on the Justification of Technology Education as General Education" (Chang); "A Case for Technological Literacy" (Martin); "Technology: The Newest Liberal Arts" (Kowal); "The Underside of Technological Literacy" (Pilotta); "Impacts of Technology" (Balistreri); "Christian Relational Theology as a Framework for Assessing Moral and Social Implications of Technology" (Arnett, Ramer); "Social Consequences of Technological Innovation" (Pucciano); "Sociotechnical Literacy: An Alternative to the Technological Perspective" (Pratzner); "A Global Model of Technological Literacy" (Hameed); "Defining, Determining, and Contributing to Technological Literacy: Getting There from Here Using the Technology of a Research Paradigm" (White); "What Price Progress? The Social Impact of Technology on Society" (Meyers); "An International Study of Curricular Organizers for the Study of Technology" (Barnes); "An Instructional Model for Electronics Technology in the Republic of China" (Shih); "'Jackson's Mill' and 'Industry and Technology Education' Project Reports as a Guide for Organizing Content for Technology Education" (Wright); "The Future of Work in America: Workers, the Workplace, and Technological Literacy" (Charner); "New Technology, New Lifestyles, and the Implications of Preservice and Inservice Vocational Teacher Education" (Worms, Worms); "Technology and Education: The Appropriate Threads for a Computer Tapestry" (Thomas); "Computer Literacy: An Essential Element of Technological Literacy" (Welty); "Computer Anxiety Levels Related to Computer Use and Teacher Inservice Educational Needs" (Malpiedi); "Energy Literacy: The Changing of Cocksure Ignorance to Thoughtful Uncertainty" (Singletary); "Florida's Assessment of Vocational Teachers' Training Needs: The First Step in a Five-Year Statewide Inservice Plan" (Patterson); "The Impact of Computer Technology on Graphic Communication" (Boyer, Bertoline); "Dichotomies, Relationships and the Development of Technological Literacy" (DeVore); "Technology's Impact on Education: Don't Leave It to Chance" (Harris); "Implications: Technological Literacy and Vocational Education Service Areas" (Ressler); "Machine Vision Literacy" (Andrews); "Technology Education in New York State" (Hacker); "Technological Literacy: Roles for Practical Arts and Vocational Education" (Maley); and "Technological Literacy: The Role of Vocational Education" (Moss). (MN)

FORMAT: Conference Proceedings, Position Paper; 240p.

TITLE: ***Technology: A National Imperative.***

DATE: 1988.

DEVELOPER: Technical Foundation of America, Lansing, IL.

AVAILABILITY: For a microfiche copy of this document, order ED302665 from FEIS.

ANNOTATION: Many changes will occur in the United States in the next decade, often occasioned by new technology. Most new jobs will be highly technical and require technical education. At the same time, however, fewer workers with the required skills may be available as the U.S. work force becomes increasingly older, more female, and more disadvantaged. Technology has been described as the application of mathematics and science for specific purposes to make life better. It also has been described as the use of knowledge, tools, and skills to increase our potential, to solve problems, and to modify the world. Faced with increasing technological change, schools are addressing many aspects of technology through a contemporary subject called "technology education." As part of the school curriculum, technology education teaches students to understand, use, and control technology. The curriculum covers the development of technology and its effect on people, the environment, and society. The increasing sophistication of the technological world has caused educators to address technology in conjunction with the study of mathematics and science. A curriculum has been developed and the parameters of technology education have been set. If parents, teachers, government officials, and corporate executives all play their parts, success in teaching technology education will result in a more educated populace that will provide the United States with the competitive edge necessary to remain as one of the most productive nations in the world. (KC)

FORMAT: Review Literature, 30p.

TITLE: **"Technology Education: Challenges and Opportunities."**

AUTHOR: Maley, Donald.

JOURNAL: *Technology Teacher*; v46 n7 p3-6 Apr 1987.

ANNOTATION: The author discusses the transition of industrial arts to technology education. He covers challenges, opportunities, and potential consequences. Management and assessment of the change process is discussed. (CH)

SERIES: **Technology Education.**

TITLE: ***Communication.***

Construction.

Manufacturing.

Transportation.

DATE: 1988.

AVAILABILITY: Sale, $10.00 each. Vocational Curriculum Lab., Cedar Lakes Conference Center, Ripley, WV 25271. (304) 372-7017.

ANNOTATION: This guide is to assist the industrial arts teacher in the development of planned programs and courses that reflect the changing philosophy and practices in industrial arts education in the state of West Virginia.

FORMAT: Curriculum Guide; Competency-based; Task Analysis; 55p.

TITLE: ***Technology Education Curriculum Guide.***

DATE: 1987.

AVAILABILITY: Loan 4 weeks. Northwestern Curriculum Coordination Center, St. Martin's College, Lacey, WA 98503. (206) 438-4456.

ANNOTATION: Provides ideas for implementing technology education. All of the tasks and their associated activities have been tested and used successfully in junior and senior high.

FORMAT: Curriculum Guide; Teacher Guide; Competency-based; Task Analysis; 70p.

TITLE: ***Technology Education Instructional Tasks—Competencies for Introduction to Technology.***

DATE: 1988.

AVAILABILITY: Sale, $9.51. Loan 4 weeks. Louis Balducci, Virginia Vocational Curriculum and Resource Center, 2200 Mountain Road, Glen Allen, VA 23060. (804) 262-7439.

ANNOTATION: Introduces middle or junior high school students to technology. Includes many innovative ideas for activities and simulations.

FORMAT: Curriculum Guide; Teacher Guide; Competency-based; Task Analysis; Criterion Referenced Evaluation; 176p.

TITLE: ***Technology Education Instructional Tasks—Competencies for Materials Processes Technology.***

AVAILABILITY: Sale, $5.00. Loan 4 weeks. Louis Balducci, Virginia Vocational Curriculum and Resource Center, 2200 Mountain Road, Glen Allen, VA 23060-2208. (804) 262-7439.

ANNOTATION: Task analyses developed for Technology Ed (Industrial Arts) classes covering nature and properties of wood, metal, ceramic, polymeric, and composite materials and the processes related to combining, separating, forming, and finishing.

FORMAT: Curriculum Guide; Teacher Guide; Competency-based; Task Analysis; Criterion Referenced Evaluation; 230p.

TITLE: ***Technology Education Program.***

DATE: 1987.

AVAILABILITY: Loan 4 weeks. Northwestern Curriculum Coordination Center, St. Martin's College, Lacey, WA 98503. (206) 438-4456.

ANNOTATION: Technology vocational core for 9th graders. Activity units and student progress forms.

FORMAT: Administrative Manual; Curriculum Guide; Teacher Guide; Behavioral Objectives; 500p.

TITLE: ***Technology Education: The Transition.***

DATE: 1988.

AUTHOR: Pedras, Melvin J.; And Others.

AVAILABILITY: For a microfiche copy of this document, order ED291898 from FEIS.

ANNOTATION: With technology constantly changing, educators are challenged to integrate technology education into the curriculum. In an effort to integrate a study of technology into the public school curriculum, educators at the University of Idaho identified the following areas as representative of modern technology literacy: computers and computer-aided drafting, robotics, principles of technology, and computer numerical control technology. In order for educators to remain abreast of new developments and to present them effectively to their students, they may need to attend workshops or conferences, and then, with limited resources, try to integrate new knowledge into a traditional curriculum. Others may need to enroll in graduate programs and pursue advanced degrees. All must constantly read and reflect on professional and technical journals. The University of Idaho is working with teachers throughout the state to assist them with the modernizing of the curriculum and is presenting workshops, seminars, and summer programs on technology in the curriculum. (KC).

FORMAT: Conference Paper; Teacher Guide; 9p.

TITLE: **"Technology Learning Activities: The Heart of the Curriculum."**

AUTHOR: Rye, Kjell-Jon.

JOURNAL: *Technological Horizons in Education*; v15 n7 p74–78 Mar 1988.

ANNOTATION: Describes some of the program characteristics and activities in the Technology Education Program at Bellevue High School (Washington). Discusses the program's involvement with robots, lasers, plotters, and computers. (TW).

TITLE: **"Technology Literacy as a Major Thrust for Technology Education."**

AUTHOR: Maley, Donald.

JOURNAL: *Journal of Epsilon Pi Tau*; v13 n1 p44–49 Win-Spr 1987.

ANNOTATION: Discusses (1) the nature and role of technology, (2) technology education and general education, (3) technological literacy and general education, and (4) technology and teacher education. Integrates these issues and supports technology as a necessary component of general education. (CH).

TITLE: **"A View from the States: Second Annual Survey of Technology Education and Trade and Industrial Education."**

AUTHOR: Dugger, William E., Jr.; And Others.

JOURNAL: *Technology Teacher*; v45 n6 p7, 9–12 Mar 1988.

ANNOTATION: Discusses data collected from state supervisors of technology education and trade and industrial education on the status of teachers, certification, starting salaries, vacancies, graduation requirements, student enrollment, and funding. (JOW).

TITLE: **"Will Technology Education Have a Place under the Sun?"**

AUTHOR: Stadt, Ronald W.

JOURNAL: *Journal of Industrial Teacher Education*; v26 n2 p46–49 Win 1988.

ANNOTATION: The author speculates that technology education could cease to exist as an elective subject at the secondary level. He outlines a multifaceted, proactive strategy to assure that the subject continues as a viable offering in the secondary school curriculum. (CH).

TITLE: **"The Woodlands, Texas."**

AUTHOR: McHaney, Larry J.; Bernhardt, Jerry.

JOURNAL: *Technology Teacher*; v48 n1 p11-16 Sep 1988.

ANNOTATION: The authors describe the "central project" concept for implementing technology education while addressing education reform. The central project is a topic around which students, teachers, administrators, and the community focus their energies as a team. At McCullough High School (Texas), the central project involved design and development of a space station. (CH).

TITLE: ***Work Now and in the Future—3. Proceedings from the Annual Conference for Business and Industry Representatives, Educators and Others Concerned with the Changing World of Work (3rd, Portland, Oregon, November 5-6, 1986).***

DATE: 1986.

AUTHOR: McClure, Larry; Cotton, Kathleen, Ed.

DEVELOPER: Office of Educational Research and Improvement (ED), Washington, DC.

AVAILABILITY: For a microfiche copy of this document, order ED277834 from FEIS.

ANNOTATION: These proceedings of a conference, which focused on technology and communications in tomorrow's workplace, include the following: synopses of "Learning for Life: Increasing Awareness of Human Capabilities" and the follow-up session "Multiplying Intelligence: What Do We Know about Learning Styles"? (Dee Dickinson); "From Programmed Instruction to Laser Videodiscs: What I've Learned after 30 Years at IBM" (Harvey Long); a banquet speech on the space program in relation to education (David Marquart); a session on distance education and its use of telecommunications and video technologies; a session on new skills needed for occupational success (chaired by David Allen); a presentation entitled "Behind the Scenes at the Sheraton" (Helen Moore); a luncheon speech on high tech applications in the news industry (Paul Glancy); five descriptions of programs to prepare students to communicate in the workplace (Bennie Lucroy et al.); a presentation on teaching young people to become decision makers (Owen Thompson); a presentation on the Principles of Technology curriculum (Leno Pedrotti) followed by a panel on the subject; "Technology in the Middle School Years: Whatever Happened to Building Birdhouses in Junior High"? (Sam Stern et al.); "A New Approach to Technology Education, K-12: The Bellevue Model" (Roger Wing et al.); "A New Approach to Technology Education, K-12: The Yakima Model" (Jim Merz); a presentation on the Business Equipment Systems Technology program (Don Wardwell); "Promising Practices for High Risk Youth in the Northwest Region: Initial Search" (Karen Green); "At-Risk Youth: Oregon's Response" (Kent McGuire, moderator); a session on the Summer Training and Employment Program (Kurt Shovlin et al.); a presentation on the Financial Services Academy (Julie Crossley et al.); "Transition Skills for Youth with Special Needs" (Jane Dowling et al.); a session on career redirection problems, needs, and resources; a demonstration of MICRO-SKILLS (Susan Roudebush); a session on cooperative work experience; "What's New in Apprenticeship?" (Jeff Triplett); a panel on drug testing; an overview of illiteracy in the workplace (Beret Harmon); "Using Vocational Materials to Develop Reading Skills" (Delores Tadlock); a session on integration of academic and vocational education; "Career Planning in the High School: Helping Students Look Ahead" (Dale Arneson, Bruce McKinlay); "How Your Agency Can Test New Materials: A National Effort to Use Products of Research" (Jay Smink); a panel on teacher preparation; "Customized Training Resources: A Blueprint for Expansion and Growth"; a session on regional planning for articulated vocational education programs; a description of Project 2001 (Bob Lehman); "An Insider's Look at Planning for the Future" (Eugene Eschbach); and "Image Building: Lessons for Education and Training from Leading Northwest Companies" (Mark Milleman et al.). The proceedings conclude with a review of the conference and participants' evaluation. (YLB).

FORMAT: Conference Proceedings; Position Paper; 47p.

INTERNATIONAL TECHNOLOGY EDUCATION ASSOCIATION

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89-113	Technology Education Public Information Handbook	DOE/NY	$4.00
89-093	Special Needs Guide for Industrial Education Programs	DOE/IL	$2.00
89-092	Sex Equity Guide for Industrial Education Programs	DOE/IL	$2.00
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89-139	Synergistic Technology Education--Model Railroad	D. Dietz	$2.00
89-134	Sample Simulation Instructional Exercises	L. Young	$4.00
89-133	An Introduction To Control Technology	J. McCade	$3.00
89-132	Using A Spreadsheet To Teach Robotics	G. Finke	$3.00
89-129	Wellesley Middle School TLA's--Grade 7	D. McAleer	$17.00
89-128	Wellesley Middle School TLA's--Grade 6	D. McAleer	$9.00
89-127	Pomona Junior High School Laser Presentation	G. Evans	$4.00
89-119	Satellite Technology	DOE/UT	$4.00
89-118	Robotic Technology	DOE/UT	$4.00
89-117	Laser Technology	DOE/UT	$5.00
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